



### DoD Executive Agent

Office of the  
Assistant Secretary  
of the Army  
(Installations and  
Environment)

## Mission Critical ESOH

### Department of Defense (DoD) Lead (Pb)-free Efforts & Technology Integration Support

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**Technology Transition – Supporting DoD Readiness, Sustainability, and the Warfighter**

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# The Pb-Free Issue

- Following the European Union's Restriction of Hazardous Substances (RoHS) Directive, many industry suppliers have begun to eliminate Pb in solder, electronic components, and circuit board finishes.
- Pb-free solder usage has been confirmed to cause electronic failures.
- There are no requirements for electronic component manufacturers to change their labeling to differentiate between traditionally processed devices and those processed using Pb-free technologies.

# The Pb-free Issue (cont'd)

- The DoD is unable to measure and verify the Pb content of incoming electronic components on a large-scale and/or to determine the prevalence of unauthorized Pb-free components in the acquisition supply chain.
- It has been confirmed that Pb-free components have been integrated into critical weapon systems and it is likely that it will continue on an increasing basis.

# Pb-free Electronics Risks

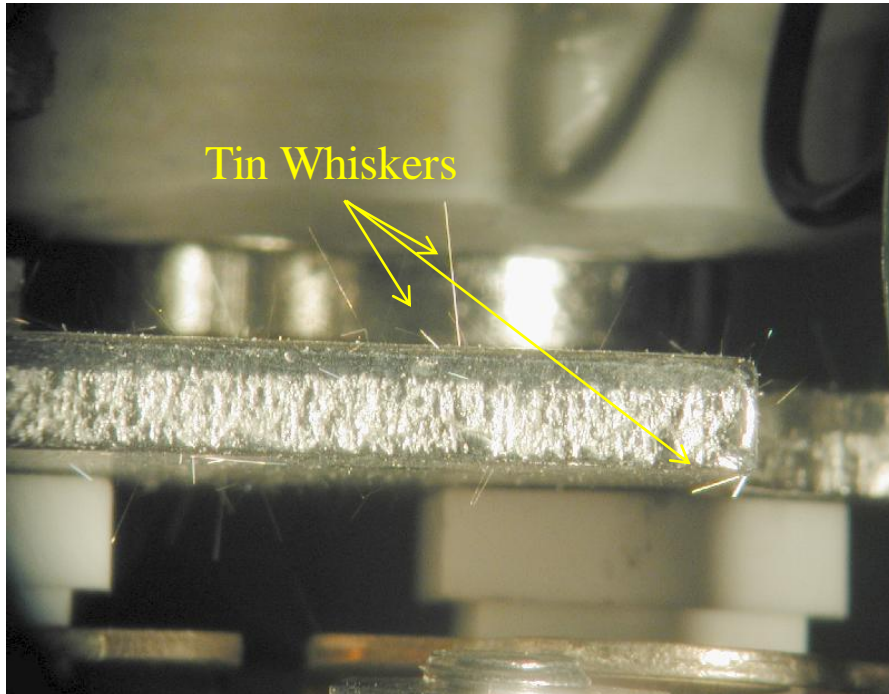


Photo courtesy of Goddard Space Flight Center

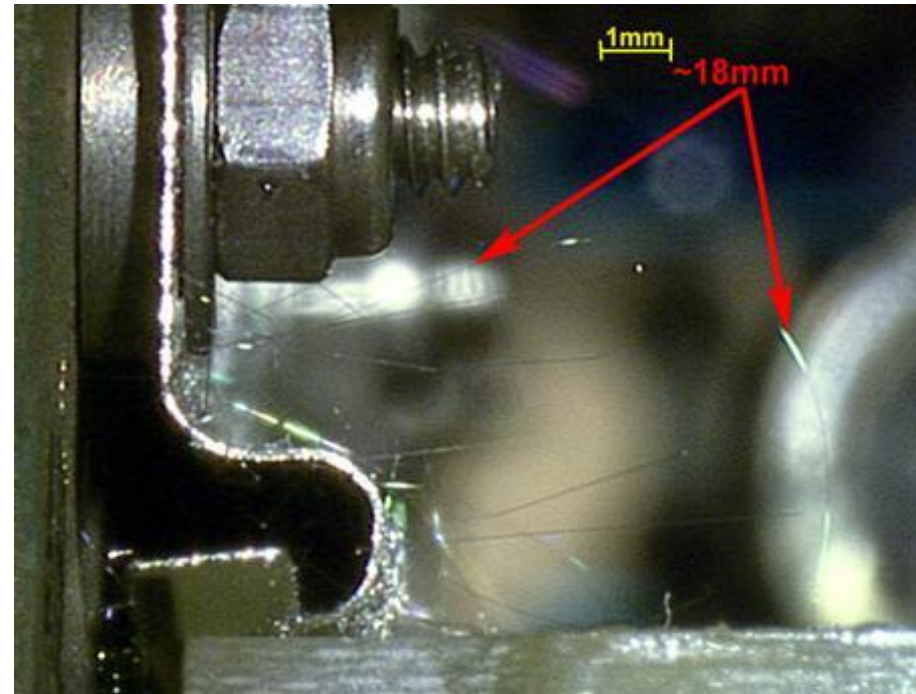


Photo courtesy of M&P Failure Analysis Laboratory,  
The Boeing Company

# Pb-free Electronics Risks

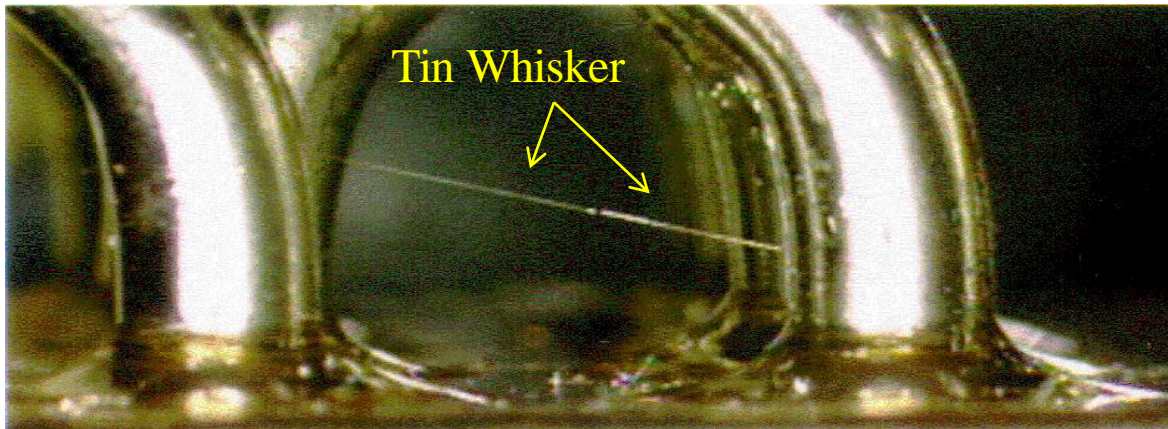
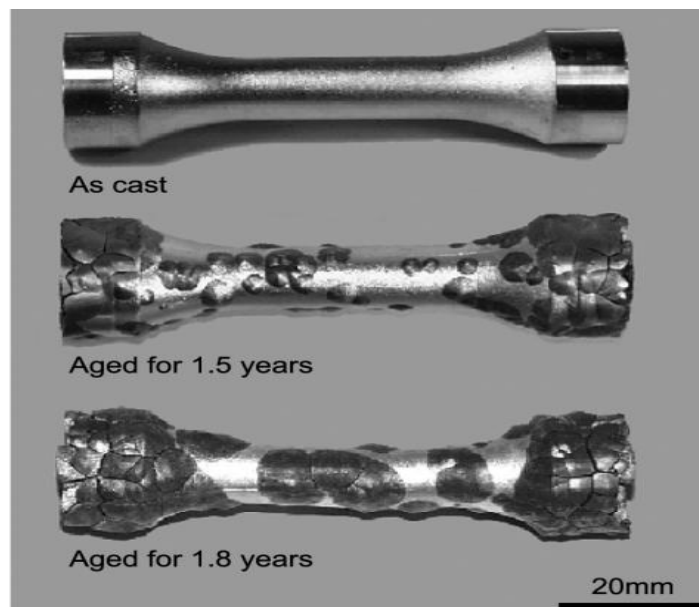


Photo courtesy  
of Goddard  
Space Flight  
Center

**Tin Plague/  
Tin Pest**



# Prior Pb-free Efforts

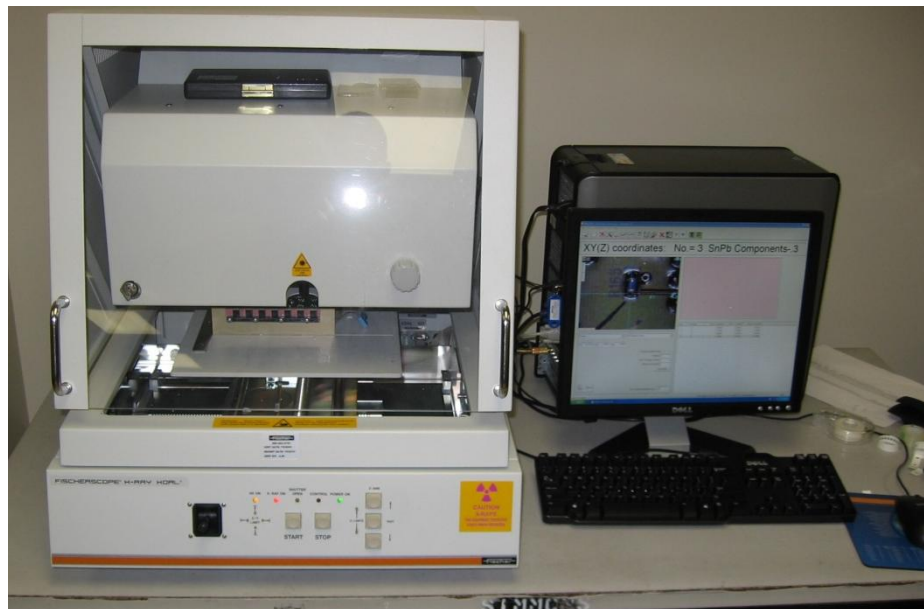
- X-ray Fluorescence (XRF) technology was evaluated at Tobyhanna Army Depot (TYAD), with results showing that 30% of new, unique materials coming through central receiving were non-compliant in regards to Pb content.
- TYAD has implemented XRF into normal operating procedures and continues to see ~12% non-compliance.
- The Lead-free Surveillance and Analysis System (LSAS) was developed to provide access to reliable information on Pb-free data for the DoD, subcontractors, and Original Equipment Manufacturers (OEMs), which is currently being used by TYAD.

# Ongoing and Future Pb-free Efforts

- Development of a Pb-free Training Course that will be hosted on the Defense Acquisition University (DAU) website and will focus on Pb-free awareness and education.
- Utilize XRF technology to conduct supplier audits of the Navy's Fire Scout Unmanned Aerial Vehicle (UAV) to ensure that materials are compliant.
- Support the development of a Fire Scout Pb-free policy to ensure that the system complies with regulations and directives while meeting performance and mission requirements.

# XRF Demonstration/Validation (Dem/Val) at Fort Rucker, AL

- Dem/Val the Fischerscope XDAL XRF spectrometer at Fort Rucker for material composition analysis of electronic materials entering the installation and also materials supplied by the Stryker Brigade Combat Team (SBCT).



Fischerscope XDAL XRF spectrometer

# Approach

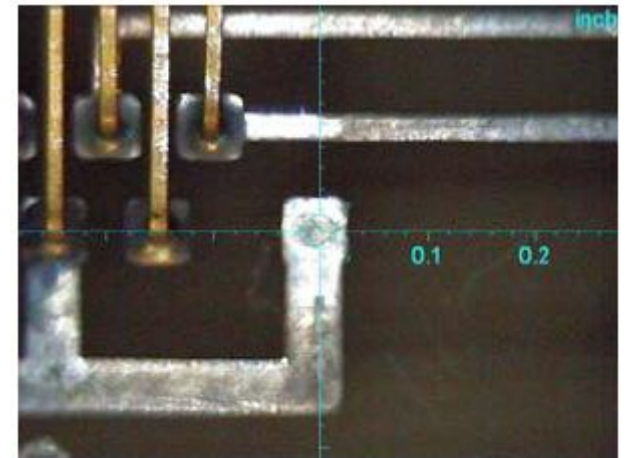
- Demonstrate the XRF unit in two different areas within Fort Rucker over three months.
  - Hanchey Avionics Shop (Hanchey).
  - Aircraft Maintenance Support Shop (AMSS).
- Validate performance against established system requirements.
  - Verify image magnification.
  - Verify x-ray collimator of the XRF unit is of sufficient size.
  - Verify that the XRF units can accurately measure metal composition and not solely Pb or Pb-free.
  - Check reproducibility /accuracy using selected materials.
  - Perform system requirements for Printed Circuit Boards (PCBs) supplied by the SBCT.



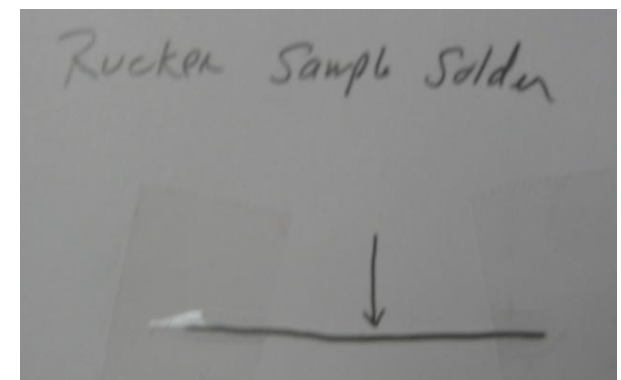
SBCT Printed Circuit Board

# Results

- Verified ability to analyze small parts.
  - Image magnification and collimator size.
- Verified ability to measure metal composition, not solely Pb or Pb-free.
  - Confirmed solder composition of certified standards, including commonly used tin, silver, copper solders.



Analysis of Auto dimmer board for an A-Molder Apache

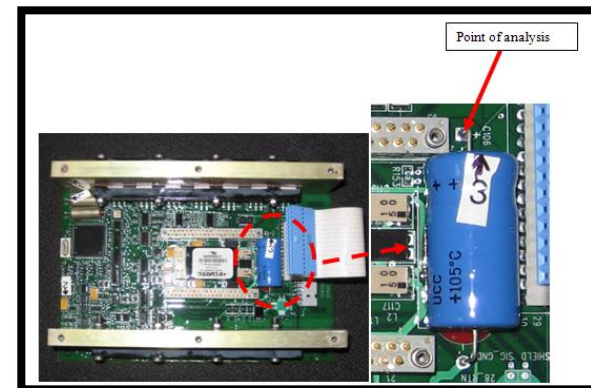


Analysis of 8N60 solder used at Ft. Rucker  
62% Tin, 37.7 % Pb

# Results (cont'd)

## System requirements testing of 25 SBCT PCBs

- 11 of the 25 had readings  $<3\%$  Pb
- Two points routinely had readings  $<3\%$  Pb
  - Point 3 --- 4 of the 17 had readings  $<3\%$  Pb
  - Point 6 --- 7 of the 14 had readings  $<3\%$  Pb



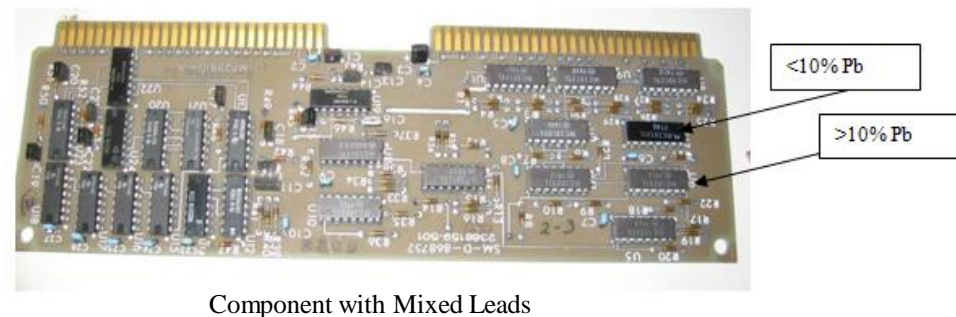
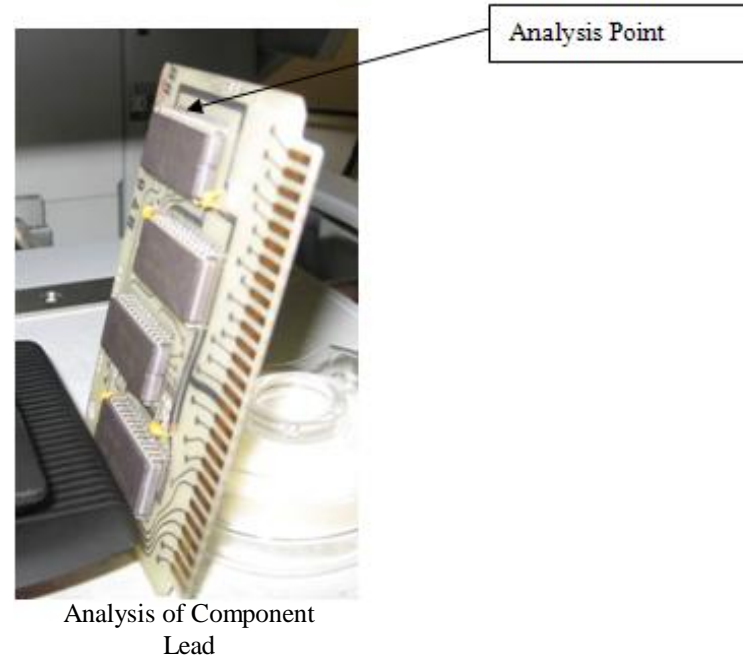
Analysis Point 3



Analysis Point 6

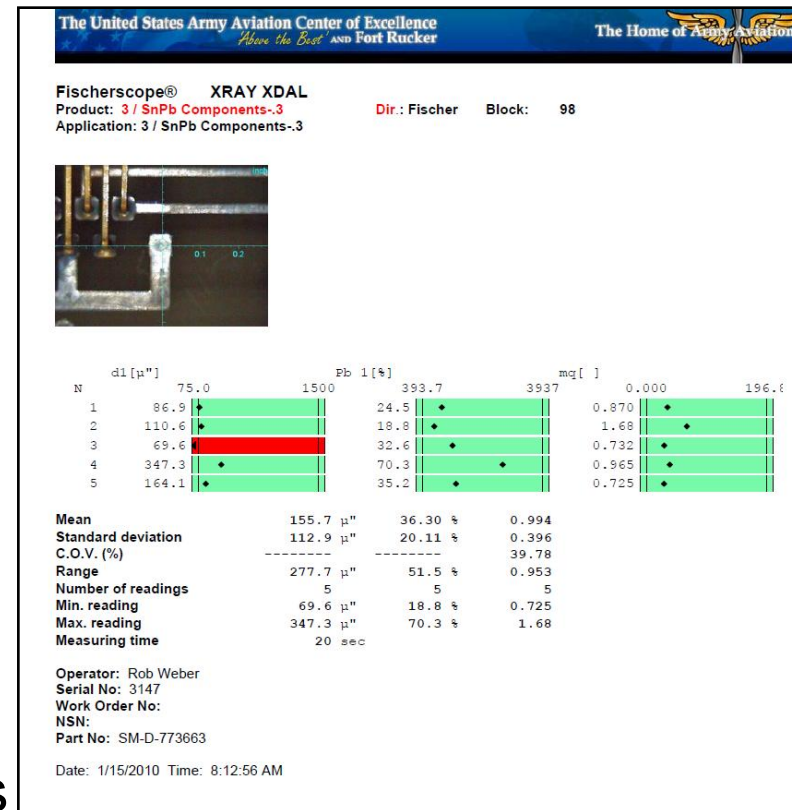
# Results (cont'd)

- 44% of parts analyzed by Fort Rucker had readings  $<10\%$  Pb.
  - 18%:  $<10 - 5\%$  Pb
  - 12%:  $\leq 5 - 3\%$  Pb
  - 14%:  $<3\%$  Pb
- Several of the non-compliant parts were reanalyzed by Hanchey staff to confirm the non-compliance.
- Several leads contained  $<10\%$  Pb.
  - Pb content was consistent on some boards and mixed on others.



# Accomplishments

- Completed hands-on XRF training for Fort Rucker staff.
  - Part placement.
  - Pb-free identification.
    - Pb results <10% were flagged red.
  - Reporting capabilities.
- Completed 102 day dem/val effort at Fort Rucker.
- Validated the system's performance against established requirements.
- Identified a number of components on existing boards/modules determined to be Pb-free (<3% Pb).



Report Generated by Unit

# Challenges

- Lack of policy
  - DRAFT Policy on Lead-Free Solders and Finishes in Defense Materiel
    - Comments were delivered 11 December 2009
- Education and Awareness
- Obsolescence

# Conclusions and Recommendations

- Concluded that the XRF unit met established technical criteria.
- Recommend the following steps to minimize the threat of Pb-free electronics.
  - Implement Pb-free identification procedures.
  - Implement Pb-free awareness and job-specific training.
  - Prepare and implement a Pb-Free Control Plan.
  - Incorporate a universal database, such as the LSAS to log analysis results, track parts, manufacturers, etc., and create a common area to designate non-compliant materials entering the supply chain.



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